

REMARKS

This Amendment is in response to the Office action mailed on December 2, 2010. A petition for 3-month extension of time, with payment (by credit card authorization) for the requisite fee, is submitted herewith. In the event any additional fees are due, kindly charge the cost thereof to our Deposit Account No. 13-2855.

Status of the Claims

Claims 11, 18, 19 and 22-26 are pending in the application. Amendments have been made to claims 11, 18, 22, and 23, and new claims 24-26 have been added to still more clearly capture the claimed invention.

Claim 11 has been amended to move language previously in the preamble of the claim into the main body of the claim so as to positively recite this language as steps of the claimed method. Further amendments to Claim 11 have been made in an effort to make the claim read better. Support for these amendments may be found at page 3, lines 7-14, of the specification. As such, these amendments do not add any new matter.

Claim 18 has similarly been amended in an effort to make the claim read better and improve clarity. Support for the amendments to claim 18 may be found at page 3, lines 18-25 of the specification, as well as in claim 18 as originally filed. No new matter has been added to claim 18.

Claims 22 and 23 have been amended in an effort to improve clarity and provide accurate antecedent basis. No new matter has been added to claim 22 or 23.

New claims 24 and 26 recite:

“...further comprising the step of forming a further layer in addition to said metal nozzle plate layer, said further layer comprising a plurality of apertures aligned with said nozzles.”

Support for claims 24 and 26 may be found in the specification as-filed, for example at page 5, lines 5-7. No new matter has been added by the addition of claim 24 or 26.

New claim 25 recites:

“each of said nozzles has a diameter and wherein said step of selectively exposing and removing said first photoresist material to define on the substrate an array of distinct bodies of said first photoresist material comprises applying a mask, said mask comprising an array of distinct mask features corresponding to said array of distinct bodies, each of said mask features having a diameter greater than the diameter of the nozzle of the corresponding body of first photoresist material.”

Basis for claim 25 may be found in the specification as-filed, for example at page 4, lines 20-28, and Figures 2b to 2e. No new matter has been added by the addition of claim 25.

Response to 35 USC § 102 Rejections

Claim 11 has been rejected under 35 USC § 102(b) for allegedly being anticipated by Gardner (US 4,246,076). In view of the present amendments, it respectfully is considered that claim 11 patentably differentiates still more clearly from Gardner and the other prior art of record.

Claim 11 as previously presented included the step of:

“...defining a plurality of distinct bodies of polymeric material distributed over the nozzle plate plane, each said body having a periphery...”

Claim 11 as currently amended includes the further step of:

“...forming a plurality of nozzles, each nozzle extending through one of said distinct bodies of polymeric material distributed over the nozzle plate plane...”

It is respectfully submitted that this step is not taught by Gardner: As shown in Figure 1e of the reference, the nozzle is formed by the complete removal of the photopolymer layers

3 and 13, so that the nozzle extends through the metallic layer 23 alone. For at least the reason that this step is not taught by Gardner, it is most respectfully submitted that claim 11 is not anticipated by Gardner. Withdrawal of the rejection under 35 USC § 102 is respectfully solicited.

Response to 35 USC § 103 Rejections

Claims 18 and 24 have been rejected under 35 USC § 103(a) for allegedly being unpatentable over Gardner (US 4,246,076) in view of Nakazawa et al (JP 06-206314). With the amendments now made, it is respectfully submitted that both claims differentiate still more clearly over the prior art made of record.

Generally speaking, the Applicant remains of the view that it is not possible to combine the actual technical teaching of Gardner and Nakazawa in a coherent manner.

Numerous such incompatibilities have been highlighted in the remarks accompanying the interviews with the Examiner, as well as in the Remarks of March 26, 2010, which are incorporated herein by reference. It is most respectfully submitted that these remain pertinent – no concrete reasoning has been given as to how one of ordinary skill in the art could overcome these problems. Indeed, it should be noted that a long-felt need and the failure of others to solve such problems are secondary considerations of non-obviousness applicable to the present case. *See, e.g., Advanced Display Systems, Inc. v. Kent State Univ.*, 212 F.3d 1272, 1285 (Fed. Cir. 2000). Courts have found that “[o]bjective considerations such as failure by others to solve the problem ... ‘may be the most probative and cogent evidence’ of nonobviousness.” *Id.*, quoting *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983). These problems, and failure of the prior art to adequately address them, are

discussed in the very references being relied upon in the Office action, as explained in more detail below.

In particular, the Office action indicates that while Gardner may not expressly disclose forming a nozzle extending through a body of photoresist material, “Nakazawa et al teaches forming a nozzle extending through a body”. As is discussed in more detail in the presentations given during the interviews and aforementioned Remarks, it is not technically possible to apply the method of nozzle formation of Figures 7-10 of Nakazawa to the steps of Gardner shown in Figures 1a to 1d, which the Office action has identified with the remaining steps of the claimed method.

The method of Gardner involves the deposition and selective curing of two layers of photopolymer (3, 13) to form an upright post of cured polymer (11, 21), as is shown in Figures 1a to 1c. A metallic layer 23 is *then* electroplated around the post structure (11, 21) of cured photoresist as shown in Figure 1d.

The nozzle formation method of Nakazawa involves the curing of an area of photoresist around the nozzle bore (5), as shown in Figure 7. The uncured photoresist within the nozzle bore (9) is then removed in the step shown in Figure 8. However, it is clear that **all** of the photoresist in Gardner *has already been cured* at the stage of Figure 1d. It is simply not technically possible to cure this photopolymer again, as is required by Nakazawa.

Further, in the method of Gardner there is no photopolymer – cured or uncured – around the nozzle bore, only electroplated metal (23), which one of ordinary skill in the art would understand cannot be cured. Indeed, the entire purpose of the use of photopolymer in Gardner is to precisely define the shape of the nozzle bore. Thus, to have photopolymer around the nozzle bore in Gardner would be a violation of the central principle of the method,

and thus contrary to the teachings of the reference. It is respectfully submitted that such a modification would not be regarded by one of ordinary skill in the art as being obvious.

Furthermore, it is noted that the Office action stated that “the advantage of forming a nozzle extending through a body is to produce a nozzle with less vibration during operation”. This is understood to mean that the Office considers that Nakazawa teaches forming a nozzle extending through a body of a first photoresist material.

Notwithstanding the arguments above that it would not be possible to combine the method of Gardner and Nakazawa to arrive at a method where a nozzle extends through a body of a first photoresist material, the Applicant must respectfully disagree that this purported advantage would result, even if such a modification could be made.

Gardner currently produces a nozzle array plate 23, where the nozzle bores are defined entirely by metal. To alter this nozzle array plate to include photoresist portions providing the nozzle bores would reduce the rigidity of the nozzle array plate in the vicinity of the nozzles – photoresist material being typically far less rigid than the materials disclosed by Gardner: “nickel, copper and various alloys” (column 2, line 54). It is likely that this decrease of rigidity in the vicinity of the nozzle would increase vibration, rather than decrease it, as the Office action posits.

It should be noted in this regard that the teaching of the abstract of Nakazawa that the method provides “a hardly vibrating nozzle plate” only refers to an improvement with respect to a nozzle plate that is formed entirely from photo-curing resin.

This is made clear from studying the electronic translation of Nakazawa, as provided by the Japanese Patent Office, and a copy of which is submitted herewith as a machine translation accompanying a Supplemental Information Disclosure Statement (a Japanese copy of Nakazawa et al, JP 06-206314, already having been submitted with a previous Information

Disclosure Statement of January 18, 2006) from which the following quotations are taken. In the description of the prior art of Nakazawa et al. (paragraph 3) there are described two different prior art methods: (1) an “ink jet head constitutes an ink channel part and a nozzle part from inorganic materials, such as metal and a silicon single crystal wafer” and “a pressure chamber, a nozzle hole, etc. are formed there by etching processing”; or (2) “an ink channel part and a nozzle part are constituted from photo-curing resin, and a light shielding mask is put on the position used as a pressure chamber, a nozzle hole, etc., it irradiates with ultraviolet rays, and the pressure chamber and the nozzle hole are made to be formed as a non-hardening portion”.

The text in paragraphs 4 and 5 of the translation of the reference discusses the problems with each of these approaches, and notes that each approach has separate and different problems associated with it: “in the case of etching processing, since a processed surface becomes tapering form gradually, there is a fault in which it is difficult to form in an exact shape dimension the nozzle hole where strict dimensional accuracy is searched for”; and in the case of photo-curing resin “accuracy will be improved by processing of a nozzle hole, but there is a fault from which the nozzle plate itself vibrates with the pressure from a driving source since the mechanical strength of material is weak, therefore print quality enough the discharge velocity of an ink droplet and good is not acquired”.

Thus, it must be appreciated that the problem of vibration is experienced with a construction formed primarily of photo-curing resin. Therefore, it can be seen how moving from such a construction to that disclosed in Figure 10 of Nakazawa et al, where a rigid substrate 1 supports a relatively far smaller amount of photo-cured resin 7, would result in increased rigidity and so decreased vibration.

Similarly, it must be appreciated that the problem of inaccurate nozzle formation is experienced with methods where a nozzle is etched in a nozzle part made of “inorganic materials, such as metal and a silicon single crystal wafer”. Nakazawa et al. addresses this problem by forming a larger, less accurate opening 5 in a substrate 1 using such an etching process (as shown in Figure 5) and then uses a relatively more accurate photo-curing process to form the nozzle hole 9 (as shown in Figures 7 and 8).

Accordingly, the Applicant considers that, firstly, Nakazawa’s teaching would actually dissuade one of ordinary skill in the art from modifying Gardner so that photopolymer was present in the finished device, since Nakazawa has noted that the more photo-cured resin there is, the less rigid the construction is, and the greater the problem with vibration becomes. As such, it is respectfully submitted that the reference teaches away from the proposed combination or modification.

Secondly, the problem noted by Nakazawa of inaccurate nozzle formation is not one that would be experienced with the method of Gardner, since the nozzles of Gardner are formed essentially by a photo-curing process, rather than an etching process.

Hence, it is considered that Gardner in fact solves both of the prior art problems posed in Nakazawa, since it is more rigid (and thus less prone to vibration) than a construction composed primarily of photo-cured resin, and provides more accurately formed nozzles than a primarily inorganic construction with etched nozzles.

Thus, one of ordinary skill in the art may view Gardner as an alternative solution to the problems faced by Nakazawa, rather than Nakazawa presenting solutions to problems faced within Gardner. Indeed, it might be argued that Gardner provides a superior solution to these problems, since an entirely metal construction may be more rigid than the part inorganic material, part photo-cured resin construction of Nakazawa. As such, it is

respectfully submitted that the person of ordinary skill in the art has no motivation to combine or modify the references as proposed in the Office action.

For at least the foregoing reasons, it is most respectfully considered that claim 18, as amended, and new 24 are patentable over the prior art made of record.

It further most respectfully submitted that similar arguments apply in favor of the patentability of amended claim 11 over the prior art made of record.

The Examiner's attention is also respectfully drawn to new claim 24, which includes the feature that:

"...each of said nozzles has a diameter and wherein said step of selectively exposing and removing said first photoresist material to define on the substrate an array of distinct bodies of said first photoresist material comprises applying a mask, said mask comprising an array of distinct mask features corresponding to said array of distinct bodies, each of said mask features having a diameter greater than the diameter of the nozzle of the corresponding body of first photoresist material."

With regard to Gardner, it should be noted that it is clearly and consistently taught in the reference that the openings in the mask 5 are of exactly the same size and shape as the nozzles, since they effectively define the nozzles.

Similarly, with regard to Nakazawa, it should be noted that it is clearly and consistently taught that the light shielding mask 8 is also exactly the same size and shape as the nozzles, since it defines the nozzle hole 9.

Thus, the teachings of these references, even when combined as proposed in the Office action, would not result in the Applicant's claim 24, which indicates that each of the mask features has a diameter greater than the diameter of the nozzle of the corresponding body of first photoresist material.

Accordingly, it is considered that claim 24 is patentable, for at least the reason that the feature recited above is neither taught nor suggested by the prior art of record and relied upon in the Office action.

Claim 19 was rejected under 35 USC § 103 as allegedly unpatentable over Gardner in view of Nakazawa et al. and further in view of Chung et al, US Patent No. 7,240,433. Inasmuch as claim 18 (from which claim 19 depends) is respectfully submitted to be patentable for the reasons indicated above, it is further submitted that claim 19 is likewise in condition for allowance.

Claim 22 was rejected under 35 USC § 103 as allegedly unpatentable over Gardner in view of Nakazawa et al. and Amrich et al, US Patent No. 7,018,418. Inasmuch as claim 11 (from which claim 22 depends) is respectfully submitted to be patentable for the reasons indicated above, it is further submitted that claim 22 is likewise in condition for allowance, even if Gardner were further modified or combined with Amrich as proposed in the Office action.

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CONCLUSION

In view of the above amendment, Applicant believes the pending application is in condition for allowance. The Examiner's reconsideration and favorable action are respectfully requested. If the Examiner has any questions that might easily be resolved by telephone, he is invited to contact the Applicant's undersigned representative at (312) 474-6300.

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Respectfully submitted,

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